DOCUMENT RESUME

ED 227 136 TM 830 130

AUTHOR Hedl, John J., Jr.
TITLE A Factor Analytic Study of the Test Anxiety Inventory and A-State Worry and Emotionality Items from the State-Trait Anxiety Inventory (Form Y).
PUB DATE Apr 82
NOTE 32p.; Paper presented at the Annual Meeting of the Southwestern Psychological Association (Dallas, TX, April 15-17, 1982).
PUB TYPE Speeches/Conference Papers (150) -- Reports - Research/Technical (143)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Adjustment (to Environment); *Factor Structure; Higher Education; *Personality Measures; Psychological Patterns; Response Style (Tests); Stress Variables; *Test Anxiety; Test Interpretation; Test Validity
IDENTIFIERS Scree Test; *State Trait Anxiety Inventory (Spielberger); *Test Anxiety Inventory (Spielberger)

ABSTRACT

The Test Anxiety Inventory (TAI) and worry and emotionality items from the State-Trait Anxiety Inventory (STAI) (Form Y) were administered to college students from three metropolitan colleges as part of several psychological experiments. The TAI was administered to a total of 543 students, and the STAI A-State items were administered twice to a significant subsample of the total data base (N = 343). Factor analyses of the TAI items indicated clear worry and emotionality factors consistent with the original TAI development. For the subsample with both TAI and A-State item data, factor analyses identified three factors: test anxiety and two state anxiety factors corresponding to the two occasions of measurement. Additional analyses suggested that occasions of measurement factors were only observed when the occasions differed significantly in A-State intensity level. When the occasions were equated for intensity level, state worry and emotionality factors were also observed. Across all analyses, the optimal solutions were selected on the basis of simple structure, psychological meaningfulness, and invariance across sex. Other solutions were reviewed but were considered less satisfactory in terms of these three criteria. Evidence concerning the discriminant concurrent validity of the TAI worry-emotionality scales as well as the STAI A-State Worry-Emotionality scales was also indicated. (Author/PN)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED227136

A Factor Analytic Study of the Test Anxiety Inventory and A-State Worry and Emotionality Items from the State-Trait Anxiety Inventory (Form Y)

John J. Hedl, Jr.

The University of Texas

Health Science Center at Dallas

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

J. J. Hedl, Jr.

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

TM 830 130

Paper presented at the meeting of the Southwestern Psychological Association, Dallas, April 1982.

Abstract

The Test Anxiety (TAI) and worry and emotionality items from the State-Trait Anxiety Inventory (Form Y) were administered to college students from three metropolitan colleges as part of several psychological experiments. The TAI was administered to a total of 543 students, and the STAI A-State items were administered twice to a significant subsample of the total data base (N = 343). Factor analyses of the TAI items indicated clear worry and emotionality factors consistent with the original TAI development. For the subsample with both TAI and A-State item data, factor analyses identified three factors: test anxiety and two state anxiety factors corresponding to the two occasions of measurement. Additional analyses suggested that occasions of measurement factors were only observed when the occasions differed significantly in A-State intensity level. When the occasions were equated for intensity level, state worry and emotionality factors were also observed.

Across all analyses, the optimal solutions were selected on the basis of simple structure, psychological meaningfulness, and invariance across sex. Other solutions were reviewed but were considered less satisfactory in terms of these three criteria. Evidence concerning the discriminant concurrent validity of the TAI worry - emotionality scales as well as the STAI A-State W-E scales was also indicated. The results were interpreted as providing strong evidence for the state-trait distinction and worry-emotionality distinction in test anxiety research with college students.

A Factor Analytic Study of the Test Anxiety Inventory and A-State Worry and Emotionality Items from the State-Trait Anxiety Inventory (Form Y)[1]

During the past decade, the literature relating test anxiety to school performance has established that high levels of anxiety are generally associated with performance decrements in the classroom (Sarason, 1972; Sarason, 1980; Spielberger, 1966; 1972; 1975). The pervasive effect appears from elementary school through college (Sarason, 1980). Regardless of age, test anxious individuals perceive evaluative, testing situations as personally threatening, and respond to them with intense emotional reactions. Evaluative situations also evoke task-irrelevant, self-centered worry responses that interfere with effective performance on complex, cognitive-intellectual tasks.

Test anxiety research and theory have benefited by incorporating salient components of a more general state-trait anxiety model (Spielberger, 1966; 1972; 1975) as well as Liebert and Morris' (1967) bidimensional distinction between worry and emotionality in terms of state anxiety. In the state-trait distinction, test anxiety is conceptualized as a situation-specific anxiety trait. Although examination situations are stressful and evoke state anxiety (A-State) reactions in most students, the magnitude of the A-State responses will depend on the student's perception of a particular test as personally threatening. Individuals with high test anxiety generally perceive examinations as more threatening than low test-anxious persons, and respond with greater elevations in state anxiety to the evaluative threat that is inherent in most test situations. In terms of state anxiety, recent theory and research indicates that these states of anxiety consist of both cognitive

concern over one's performance (worry) and physiological arousal (emotionality).

In actual examinations, worry has been most consistently and most strongly inversely related to academic performance, whether it be examination scores or course grades (Morris, Finkelstein, & Fisher, 1976; Morris, Kellaway, & Smith, 1978). Morris and Liebert (1970) showed this by computing partial correlations of anxiety-performance relationships in two studies. In computer-assisted learning, O'Neil Judd, and Hedl (1977) found worry to correlate much more negatively (-.45 to -.60) than either emotionality or state anxiety with performance. Worry alone correlated negatively with oral examination performance among medical students (Bloch & Brackenridge, 1972) and Miller Analogies Test performance among graduate school applicants (Deffenbacher, 1977). Data from studies using laboratory tasks are equally supportive of the discriminant concurrent validity of the worry and emotionaliy scales (e.g., Deffenbacher, 1978; Morris & Liebert, 1969; Morris & Perez, 1972; Holroyd, Westbrook, Wolf, & Badhorn, 1978).

Originally, from a measurement perspective, the concepts of state worry and emotionality were operationalized in scale form by Liebert and Morris (1967), but no test anxiety scale included these concepts. Recently, Spielberger, Gonzalez, Taylor, Anton, Algaze, Ross, and Westberry (1980) developed the Test Anxiety Inventory (TAI) to include trait worry and emotionality subscales. Inventory development started with the original 37-item TAS (Sarason, 1972). The items were then refined and reworded in a more general format and subjected to successive factor analyses separately for males and females. The scale development efforts yielded a 20-item inventory with eight-item subscales for worry and emotionality. Internal consistency

reliability was found to be high for the total scale scores as well as for the two subscales. The TAI total scores correlated highly with the TAS indicating high concurrent validity. More importantly, the TAI W scores correlated more negatively with grade-point averages than any other test anxiety measure for both males and females, whereas TAI Emotionality scores did not correlate with grades for either sex. Normative data is also available for the TAI.

Since its initial development, the factor structure of the TAI has not been examined. In the present study, the TAI item data were factor analyzed for college students and multiple solutions were evaluated for simple structure, psychological meaningfulness, and invariance. To compare the results to the TAI manual and to avoid the problems inherent in previous factor studies of the TAQ or TAS (Gorsuch, 1966; Richardson, O'Neil, Whitmore & Judd, 1977; Sassenrath, 1964), the data were factor analyzed separately by sex and both varimax and promax rotations were reviewed. It was predicted that TAI worry and emotionality factors would be identified. Secondary analyses were computed on a subsample of the data base that included both TAI items and state worry and emotionality items from the revised State-Trait Anxiety Inventory (Form Y). Since the variation in A-State intensity (W and E components) was different in two of the latter studies, separate analyses were executed to explore situational influences on the factor structure. It was predicted that worry and emotionality factors would be identified with both the TAI and A-State scales.

Method

Subjects

The total sample consisted of 543 students (219 males, 324 females) from

three colleges in a large metropolitan area. The majority of the students were freshman and sophomores who participated in three psychological experiments in which the TAI was administered as part of the experimental protocols. Students received course credit for their voluntary participation. The breakdown of students by the three experiments was:

Hedl and Bartlett (Note 1)	N = 144 (TAI and A-State data)
Hedl, Hedl and Weaver (Note 2)	N = 199 (TAI and A-State data)
Hedl (Note 3)	N = 96 (TAI data only)

An additional 104 students were included in the analyses for whom complete TAI data was available. In general, these additional subjects had served as pilot subjects for other research projects.

Procedure

In all of the experiments, the TAI was presented with standard instructions. With the exception of one study (Hedl et al., Note 2) in which the TAI was administered to large groups of students by their actual course instructor, the TAI was administered to groups of about 20 by a male experimenter. In general, the TAI was then followed by a variety of other tasks (e.g., anagrams, memory for sentences) and questionnaires. More detailed procedural information is presented in the original studies. The TAI factor analyses involved all 543 students.

For a significant subsample (N = 343) of the total subjects, measures of A-State were also obtained both prior to and immediately following the experimental tasks. The pre A-State scale was administered with present tense instructions (i.e., how do you feel right now), whereas the post A-State scale was administered with retrospective instructions (i.e., how did you feel during the ...).

Each A-State scale consisted of four worry items (e.g., "I feel indecisive") and four emotionality items (e.g., "I feel tense"). These eight scale items were selected on the basis of factor analyses of the 20-item A-State scale of the STAI (Form Y) in conjunction with the 20-item trait scale (Spielberger, Note 4). These analyses identified state and trait anxiety factors, as well as state worry and emotionality factors. These eight items had the highest factor loadings on their appropriate state anxiety factor.

Results

Analysis of Test Anxiety Inventory

The primary analyses focused on the TAI data for the entire sample of 543 students. Intercorrelations were computed among the 20 TAI items, and these data were factor analyzed, using a principal axis solution with squared multiple correlations as estimates of the communalities. Separate analyses were computed by sex. For each group, a scree plot (Cattell, 1966) of the eigenvalues suggested a range of 2-3 major factors. Only one eigenvalue was greater than one for females, three for the male sample. It was thought desirable to review a range of solutions to ensure that no meaningful solution was overlooked. Accordingly, two- and three-factor solutions were rotated by Kaiser's (1958) varimax and promax[2] and then evaluated in terms of simple structure, parsimony, and psychological meaningfulness. The factorial invariance of the structures for males and females was also explored by Kaiser's method (Kaiser, 1960; Kaiser, Hunka, & Bianchini, 1971) of comparing cosines among factor axes (Coefficient of Factor Similarity, CFS) as programmed by Veldman (1967). The two-factor solution had good simple structure, could be meaningfully interpreted, showed factor identity, and was consistent with prior research.

Table 1 presents the varimax two-factor solutions for the males and females; the names of each factor are indicated across the top of the table with the items and their abbreviations listed in the columns. The loadings for salient items with an absolute value of .40 or greater are reported in the table.

Insert Table I about here

For males and females, Factor 1 consisted primarily of the worry subscale items (e.g., Item 3: "Thinking about the grade I may get in a course interferes with my work on tests."). Six of the eight TAI worry subscale items (3, 4, 5, 6, 14, 17) had salient loadings on Factor 1 for both males and females. Factor II consisted of the TAI emotionality subscale items (e.g., Item 2: "While taking examinations I have an uneasy, upset feeling."). All of the emotionality items (2, 8, 9, 10, 11, 15, 16, 18) had salient loadings on this factor. For females, four other scale items loaded on both factors; for males, seven other items loaded on both factors. The two-factor solutions accounted for 52.3 and 53.4 percent of the total variance for the males and females, respectively.

The varimax-rotated loadings for the two-factor solutions were compared for invariance. Although the factor axes in the two strucutres do not correspond in the same order for males and females, they showed identity (both CFS' .99) according to the criteria of Eysenck and Eysenck (1969) and that the rotation necessary to align them amounted to little more than the reflection of one factor axis and the relabeling of axes I and II.

Three-factor solutions were also computed for the males and females and reviewed for simple structure, parsimony, psychological meaningfulness and invariance across sex. The resultant factors I and II were essentially the same as found in the two-factor solutions. Factor III, however, was poorly defined and varied across sex (four salient items for males, two for females). These salient items also tended to show salient loadings on the other factors, a lack of simple structure. The invariance comparisons were also considerably lower.

Analysis of the TAI Worry and Emotionality Items Only

To enhance the factorial purity of the results, only the TAI worry (8) and emotionality (8) subscale items were factor analyzed using similar procedures as used for the entire set of 20 items. Table 2 presents the varimax loadings for the two-factor solutions which were considered optimal using the same criteria as before.

Insert Table 2 about here

When only these 16 items are included in the analysis, simple structure is enhanced in that 13 of the items load saliently on only one factor (7 on worry, 6 on emotionality) for both males and females. Two subscale items (15, 20) loaded saliently on both factors for both males and females. Item 1 (upset) loaded saliently on both factors for males, bot only on Factor II for females. The CFS was .99 for both Factor I and II suggesting factor identity across the male-female groups.

As before, three-factor solutions were computed and reviewed. These were rejected for similar reasons as those found when the entire TAI item set was analyzed.

Analysis of TAI and A-State Data Together (N = 343)

Intercorrelations were computed among the 20 TAI items and 16 (eight pre-, eight post) STAI A-State items, and these data were factor analyzed, using a principal axis solution with squared multiple correlations as estimates of the communalities. Separate factor analyses were computed by sex. The number of factors with eigenvalues greater than 1.0 extracted for each of the six groups was eight for both males and females. For each group, a scree plot (Cattell, 1966) of the eigenvalues suggested a range of 2-4 major factors. Again a range of solutions was reviewed to ensure that no meaningful solution was overlooked. Accordingly, two-, three-, four-, five-, and six-factor solutions were rotated by Kaiser's (1958) varimax and then evaluated using the same criteria as the previous analyses. The three-factor solution had good simple structure, could be meaningfully interpreted, and showed identity across sex. Table 3 presents the varimax three-factor solutions for the males and females.

For the males and females, Factor I consisted predominantly of the pre-STAI A-State scale items, although four post A-State items had salient loadings for the males. Factor II consisted of the post A-State scale items with only one item (jittery) with a salient loading from the pre-items for the females. Factor III was a test anxiety factor which was loaded by all 20 TAI items for both males and females. For the two groups, the three-factor solutions accounted for 48 per cent of the total variance.

Insert Table 3 about here

The varimax-rotated matrices of loadings for the three-factor solutions (males and females) were evaluated for invariance. The identity between the solutions is seen by the CFS' of .99, .95, and .95 between the three factors for the males and females.

Two-, four-, five-, and six-factor solutions were also rotated and reviewed, but these solutions were considered less satisfactory than the three-factor solutions. The two-factor solutions showed good simple structure and the invariance comparisons were excellent. The first three factors in the four-factor solutions were similar to the factors in the three-factor solutions and the fourth-factor was poorly defined. Since the salient items on the fourth factor varied with sex and also had salient loadings on the test anxiety factor, this solutions was lacking in simple structure, and invariance. The first three factors in the five-factor solutions were similar to the three-factor solutions, but the fourth and fifth factors were poorly defined and the salient items differed markedly across sex. The six-factor solution was rejected for similar reasons. Collectively, the three-factor solutions reveal highly similar factor patterns for male and female college students.

Influence of A-State Intensity Levels on the Factor Structure

Since levels of A-State intensity level appear to be an important determinant of factor structure (e.g., Gaudry & Poole, 1975), a series of secondary factor analyses were calculated on a subset of the data in which the A-State levels differed significantly and compared to the data which showed similar pre-post levels. For the Hedl et al. (Note 2) study, both males and females showed significant increases in worry and emotionality across the

pre-post periods (correlated *t*'s for worry = 9.34, 10.02; for emotionality *t*'s = 4.98, 6.65; all *p*'s .0001). In contrast, the pre-post A-State differences were not significant for the Hedl and Bartlett (Note 1) study. Therefore, the factor analyses were computed for all of the data in these two studies separately by sex (140 males, 203 females) and then separately by study (and by sex) to explore the impact of A-State intensity levels on observed factor structure. Only the A-State data were included in these analyses.

For the data from both studies, principle axis factors were extracted for each of the two groups and the number of eigenvalues greater than one was four for both males and females. Scree plots of the eigenvalues suggested that two or three factors should be extracted and two-, three-, and four-factor solutions were rotated by varimax for males (N = 140) and females (N = 203) separately. For both groups, Factor I consisted of the eight A-State items administered prior to the experimental sessions; Factor II consisted of the eight items from the post sessions. With the exception of Items 2 and 3 of the pre-A-State administration for females, all items loaded uniquely on a factor indicating good simple structure. The CFS' were excellent (both .99) for both factors in comparing the male and female solutions. The three- and four-factor solutions were deemed less satisfactory for similar reasons as before (lack of simple structure, variance across sex). Factors associated with worry or emotionality were not observed in the analyses.

The impact of stress level variations does appear for the Hedl et al. (Note 2) study (92 males; females 107). As with the combined analysis, clear factors were found for the pre-post occasions of measurement. As indicated in Table 4, the two-factor solutions were similar for both males and females (both CFS values .99). The three- and four-factor solutions were rejected for

Insert Table 4 about here

similar reasons as with the combined A-State factor analyses. Again, factors associated with state worry and/or emotionality were not observed.

Similar analyses were conducted for the Hedl and Bartlett (Note 1) study in which similar A-State levels were observed across the pre-post periods (48 males, 96 females). As indicated in Table 4, no clear-cut factors for occasions of measurement were noted, and the factor structures varied markedly by sex. For males, a general state anxiety factor was observed in the two-factor solution with 12 of 16 items salient. Factor II in this solution consisted of the pre-post state worry items 5 and 6 and one emotionality item (4). For females, Factor I consisted primarily of pre-post emotionality items (2,3,4) and one worry item (5). Factor II consisted of two pre-worry items (1,8) and three post worry (1,6,8) and one emotionality item. As before, the three- and four-factor solutions were also quite varied by sex.

In comparing the results of both studies, it appears that differences in A-State intensity levels do appear to influence the resultant factor structures, and the influence is observable in both the male and female data. Clear-cut factors for state worry and emotionality did not emerge, although worry items 5 and 6 (confused, indecisive) were salient in several solutions.

Discussion

In the present study that included students from three metropolitan colleges across a series of experiments, the factor analyses of the TAI showed two clear factors, one for worry and one for emotionality. This pattern was

observed independently for males and females. The two-factor solutions were selected on the basis of simple structure, parsimony, psychological meaningfulness, and invariance, after reviewing scree plots and two different solutions (both varimax and promax) for males and females. The pattern was observed when all 20 TAI items were factor analyzed, and was enhanced when only the 16 worry and emotionality items were included in the analyses.

The magnitude and pattern of the factor loadings compare quite favorably to those reported in the TAI manual (Spielberger et al., 1980). Items that were clearly W or E items in this study (i.e., only one salient loading) showed precisely the same pattern in the manual. The items that loaded saliently on both factors also showed the same pattern in the TAI manual.

As to be expected, the inclusion of only the 16 worry and emotionality items enhanced factorial purity. These analyses also indicated two items (15,20) that loaded on both factors for the males and females. The same findings were noted in the manual but the items tended to have higher loadings on its factor, although all loadings were salient. Interestingly, Item 2 (upset) showed exactly the same pattern as the manual. That is, it loaded saliently on both factors for males, and on Factor I (worry) for females. The remaining 13 items showed salient loadings only on the factor to which they were assigned in the manual.

In addition to separate factors for TAI worry and emotionality, the TAI W and E subscale scores also showed discriminant concurrent validity with self-reported grade-point averages. In general, TAI W scores correlated more highly with GPA (mean $\underline{r}$ = -.36) than did the TAI E scores (mean $\underline{r}$ = -.24). The difference between the magnitude of these correlations was significant in

three of the four studies. This pattern of correlations was also noted in the TAI manual. The difference in the magnitude of the correlations might be enhanced if the two or three items that load on both TAI factors were eliminated from the subscales. Reliability might be compromised, however, due to the shortened length of the scales.

The secondary analyses that focused on the TAI and STAI A-State items indicated three factors: a test anxiety factor and two A-State factors, one for each occasion of measurement. This pattern was observed independently for males and females. The three factor solutions were selected using the same criteria as before and after reviewing scree plots and five different factorial solutions (both varimax and promax) for males and females. These results are consistent with the findings of other studies in which a similar instrument, the A-Trait scale of the State-Trait Anxiety Inventory, was factored together with STAI A-State items using high school and college students (Gaudry, Vagg & Spielberger, 1975; Spielberger, Gorsuch, & Lushene, 1970). The results provide evidence of the importance of a state-trait distinction in test anxiety research.

From a methodological perspective, the results of the secondary analyses of the STAI A-State item data suggest the importance of A-State intensity level in overshadowing the worry-emotionality distinction. Clear-cut factors associated with occasions of measurement were noted when worry and emotionality scores varied signficantly across the experimental periods, but not when the periods did not vary significantly. This finding fits nicely with previous research. Gaudry et al. (1975) found factors for occasions of measurement with high school and college students and their sessions differed

in mean A-State levels. Hedl and Papay (in press) did not find factors associated with occasions of measurement, but their experimental sessions yeielded similar levels of A-State intensity. This interpretation should be tempered by the fact that these data are from two separate studies in which students were not randomly assigned to the experiments. Second, the experiments were also characterized by different levels of A-State intensity.

The strength of the state worry-emotionality distinction might be improved if analyses were conducted to minimize the contamination with differences in A-State intensity in the two experiments. Therefore, subsidiary analyses that only included the 16 TAI items (8 worry; 8 emotionality) and the eight pre A-State items were conducted separately by sex. After reviewing two-, three-, and four-factor solutions, the four-factor solutions were selected as optimal for similar reasons as before. TAI worry and emotionality factors were identified as were A-State worry and emotionality factors. The state-worry factor was less strong than the state-emotionality factor and this finding was similar to that found by Spielberger and his colleagues in factor analyses of the STAI Trait and A-State scales (Form Y) (Spielberger, Note 4). The emergence of the A-State worry and emotionality factors provides some evidence regarding the legitimacy of defining the STAI A-State items as W-E items.

Even though the level of A-State intensity may be important in blurring the W-E distinction, the STAI A-State W and E scores showed discriminant concurrent validity with a number of outcome measures in the various experiments. For example, as to be expected, neither state W or E scores were significantly related to college GPA. But, W scores were negatively related to anagram performance in the Hedl et al. (Note 2) study; E scores showed no

relation. And, in the Hedl and Bartlett (Note 1) study, state W scores were negatively related to several performance measures (free recall, cued recall). The worry scores were also influenced by the experimental conditions; the E scores were generally unresponsive. Collectively, the factor analytic results, the variations of W and E scores as a function of conditions, and the differential pattern of correlations with performance suggests that the STAI A-State items can be used to operationalize the constructs of state worry and emotionality.

The length of time between the pre-post assessments does not appear to be related to the factor structure either -- only the differences in A-State intensity levels. In the present study, the pre-post measurements were separated in time by about 30-45 minutes, similar to the Hedl and Papay (in press) study. Factors associated with occasions were noted in the former study but not the latter. Similarly, the assessments were separated by weeks in the Gaudry et al. (1975) study and these factors again were observed. As previously noted, Gaudry et al. (1975) showed differences in A-State intensity. Collectively, these findings indicate the importance of situational factors on resultant factor structures when using trait and state anxiety variables.

In summary, the results of the present study provide strong evidence of the multidimensionality of the TAI - clear worry and emotionality factors were identified consistent with the TAI manual information. The consistency of the findings for males and females is also noteworthy. The secondary analyses indicated that trait test anxiety and state anxiety factors associated with occasions of measurement could be identified. These analyses also suggested

the importance of situational stress levels on the observed factor structure. Evidence for state worry and emotionality factors was identified when differences in A-State intensity level were taken into account. Discriminant concurrent validity was also noted for both the trait and state scales of worry and emotionality. Collectively, these findings nicely support both the state-trait distinction and the worry-emotionality distinction in test anxiety research.

Reference Notes

1. Hedl, J. J., Jr., & Bartlett, J. Test anxiety and sentence memory. Paper presented at the meeting of the American Educational Research Association, Los Angeles, April 1981.

2. Hedl, J. J., Jr., Hedl, J. L., & Weaver, D. B. The effects of humor on anxiety and performance. Paper presented at the meeting of the American Educational Research Association, Los Angeles, April 1981.

3. Hedl, J. J., Jr. Test anxiety and attitudes toward humor in classroom examinations. Unpublished manuscript, 1981.

4. Spielberger, C. D. Personal communication, October 26, 1978.

References

Bloch, S., & Brackenridge, C. J. Psychological, performance and biochemical factors in medical students under examination stress. Journal of Psychosomatic Research, 1972, 16, 25-33.

Cattell, R. B. The scree test for the number of factors. Multivariate Behavioral Research, 1966, 1, 245-276.

Deffenbacher, J. L. Relationship of worry and emotionality to performance on the Miller Analogies Test. Journal of Educational Psychology, 1977, 69, 191-195.

Deffenbacher, J. L. Worry, emotionality, and task-generated interference in test anxiety: An empirical test of attentional theory. Journal of Educational Psychology, 1978, 70, 248-254.

Eysenck, H. J., & Eysenck, S. B. G. Personality structure and measurement. London: Routledge & Kegan Paul, 1969.

Gaudry, E., & Poole, C. A further validation of the state-trait distinction in anxiety research. Australian Journal of Psychology, 1975, 27, 119-125.

Gaudry, E., Vagg, P., & Spielberger, C. D. Validation of the state-trait distinction in anxiety research. Multivariate Behavioral Research, 1975, 10, 331-341.

Gorsuch, R. L. The general factor in the Test Anxiety Questionnaire. Psychological Reports, 1966, 19, 308.

Hedl, J. J., Jr., & Papay, J. P. The factor structure of the State-Trait Anxiety Inventory for Children: Kindergarten through the fourth grades. Personality and Individual Differences, in press.

Holroyd, K. A., Westbrook, T., Wolf, M., & Badhorn, E. Performance, cognition, and psychological responding in test anxiety. Journal of Abnormal Psychology, 1978, 87, 442-451.

Kaiser, H. F. The varimax criterion for analytic rotation in factor analysis. Psychometrika, 1958, 23, 187-200.

Kaiser, H. F. The application of electronic computers to factor analysis. Educational and Psychological Measurement, 1960, 20, 141-151.

Kaiser, H. F., Hunka, S., & Bianchini, J. Relating factors between studies based upon different individuals. Multivariate Behavioral Research, 1971, 6, 409-422.

Liebert, R. M., & Morris, L. W. Cognitive and emotional components of test anxiety: A distinction and some initial data. Psychological Reports, 1967, 20, 975-978.

Morris, L. W., Finkelstein, C. S., & Fisher, W. R. Components of school anxiety: Developmental trends and sex differences. Journal of Genetic Psychology, 1976, 128, 49-57.

Morris, L. W., Kellaway, D. S., & Smith, D. H. The Mathematics Anxiety Rating Scale: Predicting anxiety experiences and academic performance in two groups of students. Journal of Educational Psychology, 1978, 70, 589-594.

Morris, L. W., & Liebert, R. M. The effects of anxiety on timed and untimed intelligence tests: Another look. Journal of Consulting and Clinical Psychology, 1969, 33, 240-244.

Morris, L. W., & Liebert, R. M. The relationship of cognitive and emotional components of test anxiety to physiological arousal and academic performance. Journal of Consulting and Clinical Psychology, 1970, 35, 332-337.

Morris, L. W., & Perez, T. L. Effects of interruption on emotional expression and performance in a testing situation. Psychological Reports, 1972, 31, 559-564.

O'Neil, H. F., Jr., Judd, W. A., & Hedl, J. J., Jr. State anxiety and performance in computer-based learning environments. In J. E. Sieber, H. F. O'Neil, Jr., and S. Tobias (Eds.), Anxiety, learning and instruction. Hillsdale, N. J.: Erlbaum, 1977.

Richardson, F. C., O'Neil, H. F., Jr., Whitmore, S., & Judd, W. A. Factor analysis of the Test Anxiety Scale and evidence concerning the components of test anxiety. Journal of Consulting and Clinical Psychology, 1977, 45, 704-705.

Sarason, I. G. Experimental approaches to test anxiety: Attention and the uses of information. In C. D. Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol. 2). New York: Academic Press, 1972.

Sarason, I. G. (Ed.) Test anxiety: Theory, research and applications. Hillsdale, New Jersey: Erlbaum, 1980.

Sassenrath, J. M. A factor analysis of rating-scale items on the test anxiety questionnaire. Journal of Consulting Psychology, 1964, 28, 371-377.

Spielberger, C. D. Theory and research on anxiety. In C. D. Spielberger (Ed.), Anxiety and behavior. New York: Academic Press, 1966.

Spielberger, C. D. Anxiety as an emotional state. In C. D. Spielberger (Ed.), Anxiety: Current trends in theory and research (Vol. 1). New York: Academic Press, 1972.

Spielberger, C. D. Anxiety: State-trait process. In C. D. Spielberger and I. G. Sarason (Eds.), Stress and anxiety (Vol. 1). Washington, D.C.: Hemisphere/Wiley, 1975.

Spielberger, C. D., Gonzalez, H. P., Taylor, C. J., Anton, W. D., Algaze, B., Ross, G. R., & Westberry, L. G. Preliminary professional manual for the Test Anxiety Inventory. Palo Alto, California: Consulting Psychologists Press, 1980.

Spielberger, C. D., Gorsuch, R. L., & Lushene, R. E. Test manual for the State-Trait Anxiety Inventory. Palo Alto, California: Consulting Psychologists Press, 1970.

Vagg, P. R., Spielberger, C. D., & O'Hearn, T. P., Jr. Is the State-Trait Anxiety Inventory multidimensional? Personality and Individual Differences, 1981, 1.

Veldman, D. J. Fortran programming for the behavioral sciences. New York: Holt, Rinehart, and Winston, 1967.

Footnotes

1. The data analyses for this study were partially supported by an institutional research grant dealing with test anxiety and memory. The author wishes to thank Charles Spielberger and Peter Vagg for their editorial comments on an earlier version of the manuscript. The author would like also to thank Patsy Moore, Chris Claeson, and Terri Flowers for typing, editing, and clerical efforts associated with the study. Kent Dana was very helpful in adapting the computer program for Kaiser's method for evaluating factor invariance for use in this study. Frank Burns also assisted with some of the data analyses. Requests for copies should be directed to John J. Hedl, Jr., School of Allied Health Sciences, The University of Texas Health Science Center at Dallas, Dallas, Texas 75235.
2. The promax solutions tended to give essentially the same results as the varimax ones. In general, the loadings were slightly higher and the pattern was maintained, both of which are typical of promax.

Table 1

Varimax Loadings for Males and Females for

the Test Anxiety Inventory

TAI Item	TAI Subscale	Factor I (Worry)		Factor II (Emotionality)	
		Males	Females	Males	Females
1. Confident				44	59
2. Upset	E	52		48	70
3. Thinking about grades	W	61	67		
4. Freeze up	W	68	69		
5. Getting through school	W	61	52		
6. Confused	W	49	58		
7. Thoughts interfere with concentration	W	58	72	40	
8. Jittery	E			63	71
9. Prepared/Nervous	E			64	61
10. Uneasy	E			59	51
11. Tense	E	40		62	75
12. Exams bother me		50	48	51	60
13. Tense/stomach upset		43	46	46	
14. Defeat myself	W	57	69		
15. Panicky during tests	E	62	58	50	55
16. Worry before tests	E	40		59	66
17. Consequence of failing	W	65	58		
18. Heart beating fast	E			58	45
19. Can't stop worrying		(39)	64		
20. Nervous/Forget facts	W	59	56	45	43
% Total Variance		46 %	7 %	7 %	46 %

*To facilitate discussion of the results, Factor I has been labeled worry and Factor 2 labeled emotionality for both males and females. These do not correspond to the order of extraction which is indicated by the percent of total variance accounted for by the particular factor. This is true for all of the tables.

Table 2

Varimax Loadings for Males and Females for

the Test Anxiety Inventory Subscales Only

TAI Item	TAI Subscale	Factor I (Worry)		Factor II (Emotionality)	
		Males	Females	Males	Females
2. Upset	E	50		49	67
3. Thinking about grades	W	60	66		
4. Freeze up	W	66	70		
5. Getting through school	W	61	52		
6. Confused	W	52	59		
7. Thoughts interfere with concentration	W	59	72		
8. Jittery	E			66	72
9. Prepared/Nervous				68	61
10. Uneasy	E			60	53
11. Tense	E			66	75
14. Defeat myself	W	59	70		
15. Panicky during tests	E	63	54	47	59
16. Worry before tests	E			59	65
17. Consequences of failing	W	64	58		
18. Heart beating fast	E			51	48
20. Nervous/Forget facts	W	60	56	45	42
% Total Variance		91 %	92 %	9 %	11 %

tf/1608A

Table 3

Varimax Loadings for Males and Females for the A-State Scales and Test Anxiety Inventory

	Factor I (Pre-State Anxiety)		Factor II (Post-State Anxiety)		Factor III (Test Anxiety)	
	Males	Females	Males	Females	Males	Females
STAI-A-State						
Pretest						
1. Worried	61	64	42			
2. Tense	48	62	56			
3. Nervous	40	67	58			
4. Jittery	(28)	63	43			
5. Confused	49	57				
6. Indecisive	50	44				
7. Frightened	54	68				
8. Misfortunes	53	57				
Posttest						
1. Worried			71	67		
2. Tense			82	63		
3. Nervous			86	75		
4. Jittery		41	72	55		
5. Confused			59	70		
6. Indecisive			42	40		
7. Frightened			51	48		
8. Misfortunes			(39)	(34)		

Table 3 (Continued)

	Factor I (Pre-State Anxiety)		Factor II (Post-State Anxiety)		Factor III (Test Anxiety)	
	Males	Females	Males	Females	Males	Females
TAI Items						
1. Confident during tests					63	48
2. Uneasy, upset feeling					71	64
3. Grade/test interference					60	62
4. Freeze up on exams					67	62
5. Getting through school					49	56
6. Confusion during tests					46	48
7. Thoughts interfering with concentration					63	71
8. Jittery					69	63
9. Even when prepared, still nervous					57	64
10. Uneasy feeling before getting test back					55	52
11. Tense during tests					72	69
12. Exams bother me					78	71
13. Tense/stomach upset					58	65
14. Defeat myself on tests					70	73
15. Panicky during tests					72	77
16. Worry before tests					68	65
17. Consequences of Failing					62	66
18. Heart beating fast					59	48
19. Worrying after test					56	60
20. Nervous/Forget facts					72	72
% Total Variance	5.4 %	11 %	12.7 %	6.4 %	30.6 %	31 %

Table 4

Varimax Loadings for Males and Females for the Pre-Post STAI Worry and Emotionality Items Under Varying A-State Levels

STAI Item		Varying A-State Levels				Constant A-State Levels			
		Factor I		Factor II		Factor I		Factor II	
		Males	Females	Males	Females	Males	Females	Males	Females
Pretest									
1. Worried	W	67	82			79			75
2. Tense	E	71	72			74	67		
3. Nervous	E	69	64			80	87		
4. Jittery	E	70	45				77		
5. Confused	W	62	48				46	58	
6. Indecisive	W	52	56					55	
7. Frightened	E	61	70			51	43		
8. Misfortunes	W	61	70			48			75
Posttest									
1. Worried	W			66	67	68			77
2. Tense	E			59	72	70	64		45
3. Nervous	E			67	82	76	76		
4. Jittery	E			54	73	63	60	53	
5. Confused	W			73	51			72	
6. Indecisive	W			48	46			63	49
7. Frightened	E			59	58	69			63
8. Misfortunes	W			41	51	56			71
% Total Variance		37 %	13.8 %	14 %	38.5 %	42.7 %	38.9 %	13 %	14.9 %